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Impact of feather removal on the proximate composition of quail Head (*Coturnix japonica*): A comparative study

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Abstract

The present study was undertaken to evaluate the effect of feather removal on the proximate composition of quail head, an underutilized poultry by-product with potential applications in food and feed industries. Each fifteen numbers of fresh quail heads were collected with feathers and without feathers and analyzed for moisture, crude protein, ether extract, crude fibre, and total ash using standard methods. The results showed that moisture content was significantly higher ($p < 0.05$) in samples without feathers (70.77 ± 0.53%) compared to those with feathers (68.31 ± 0.31%). Crude protein and crude fibre contents were significantly higher ($p < 0.05$) in samples with feathers 22.10 ± 0.41% and 4.64 ± 0.52%, respectively. Ether extract (12.45 ± 0.26% and 13.17 ± 0.35%) and total ash (33.31 ± 1.16% and 32.98 ± 0.99%) did not differ significantly ($p > 0.05$) between the two groups. The findings indicate that the presence of feathers alters the proximate composition by increasing crude fibre and apparent protein content due to keratin, whereas removal of feathers provides a more accurate representation of nutritionally available components and improves overall nutritional quality.

Keywords: Quail head, proximate composition, feathers, by-product

Introduction

The rapid expansion of the poultry processing industry has generated substantial quantities of by-products, such as heads, feet, viscera, skin, and bones. Efficient utilization of these by-products is essential to enhance economic returns and minimize environmental pollution associated with their disposal. Poultry by-products are known to contain appreciable amounts of proteins, lipids and minerals and therefore possess significant potential for conversion into value-added products such as functional foods, nutraceuticals and animal feed ingredients (Nollet &Toldrá, 2011; Khiari *et al.*, 2014) [3, 4].

Japanese quail (*Coturnix japonica*) has gained considerable importance in recent years due to its fast growth rate, early maturity and adaptability to diverse environmental conditions. With the increasing production of quail meat, there is a corresponding rise in the availability of processing by-products. Among these, quail head represents a bone-rich material containing residual muscle, connective tissue and minerals, which may contribute significantly to its nutritional value. Previous studies have reported that poultry by-products contain moisture levels ranging from 60–75%, crude protein between 17–25% and relatively high ash content due to the presence of skeletal components (Genchev *et al.*, 2008; Park *et al.*, 2013) [2, 5].

During processing, quail heads may be handled either with feathers or after feather removal. Feathers are primarily composed of keratin, a fibrous and structurally complex protein that is poorly digestible and behaves differently from muscle proteins in proximate analysis (Nollet &Toldrá, 2011) [4]. The inclusion of feathers may therefore influence the estimation of crude protein and crude fibre, potentially leading to misinterpretation of the nutritional value of the material. Proximate analysis provides fundamental information regarding the nutritional composition of food materials and is widely used to evaluate the suitability of unconventional resources for food and feed applications (Pearson, 1976) [6]. Determination of moisture, crude protein, ether extract, crude fibre and ash content offers insight into the nutritional quality and possible applications of the material.

Therefore, the present study was undertaken to evaluate and compare the proximate composition of quail head with and without feathers using standard analytical methods, with the objective of assessing its nutritional potential and suitability for value-added applications.

Materials and Methods

Fresh quail heads were collected during slaughter from the Department of Livestock Products Technology, Veterinary College and Research Institute, Tirunelveli. The samples were hygienically packed and stored in a freezer in two forms: quail heads with feathers and quail heads without feathers. In the latter group, feathers were manually removed prior to analysis. All samples were thoroughly washed with potable water to remove adhering blood and

extraneous materials. The cleaned quail heads were then chopped into small pieces and homogenized using a mechanical grinder to obtain a uniform mass. The homogenized samples were subsequently used for further analysis.

Proximate composition of the samples was determined following standard procedures described by AOAC (2000) [1]. Moisture content was estimated by drying the samples in a hot air oven at 105°C until constant weight was achieved. Crude protein was determined using the Kjeldahl method, where nitrogen content was multiplied by a conversion factor of 6.25. Ether extract (crude fat) was measured using Soxhlet extraction with petroleum ether as solvent. Crude fibre content was determined by sequential acid and alkali digestion. Total ash content was estimated by incinerating the samples in a muffle furnace at 550°C until a constant weight of ash was obtained.

The data obtained were expressed as mean and standard error. Statistical analysis was performed using an independent sample t-test to determine significant differences between quail head with feather and without feather. Differences were considered statistically significant at $p < 0.05$.

Results and Discussion

The proximate composition of quail head with and without feathers is presented in Table 1.

Moisture

In the present study, moisture content was highly significant ($p < 0.01$) in quail head without feather (70.77%) compared to with feather (68.31%). The increase in moisture following feather removal may be attributed to the elimination of keratin, which is a dry structural protein, thereby increasing the relative water proportion. The observed values are consistent with previous reports. Genchev *et al.* (2008) [2] reported a moisture content of 72.10% in Japanese quail carcass tissues. Similarly, Park *et al.* (2013) [5] observed moisture content of 69.84% in chicken head. The values obtained in the present study are comparable to these findings, confirming that quail head possesses high moisture typical of animal tissues. The slightly lower moisture in feathered samples may be due to dilution by low-moisture feather components**.**

Table 1: Comparison of proximate composition (%) of quail head

Parameter	With Feathers	Without Feathers	t-value	p-value
Moisture (%)	68.31 ± 0.31	70.77 ± 0.53	3.94	0.002**
Crude Protein (%)	22.10 ± 0.41	20.61 ± 0.57	2.32	0.031*
Ether Extract (%)	12.45 ± 0.26	13.17 ± 0.35	1.62	0.118^{NS}
Crude Fibre (%)	4.64 ± 0.52	0.15 ± 0.01	8.67	0.001**
Total Ash (%)	33.31 ± 1.16	32.98 ± 0.99	0.33	0.742^{NS}

Values are expressed as mean ± SE (n = 15). Statistical analysis was performed using independent sample t-test.

Crude Protein

Crude protein content showed a significant difference ($p < 0.05$) in quail head with feather (22.10%) than without feather (20.61%). This increase is mainly due to keratin present in feathers, which contributes to nitrogen estimation in the Kjeldahl method. Comparable findings have been reported by Khiari *et al.* (2014) [3], who documented crude protein content of 23.42% in poultry by-product mixtures containing bone and connective tissue. Furthermore, Nollet and Toldrá (2011) [4] reported crude protein content of approximately 85% in feather meal due to keratin. Thus, although feathered samples showed higher crude protein, this represents non-available protein, whereas the lower value in featherless samples reflects more nutritionally utilizable protein. This distinction is crucial for interpreting the biological value of the material.

Ether Extract (Fat)

Ether extract did not differ significantly ($p > 0.05$) between treatments, with values of 12.45% (with feather) and 13.17% (without feather). The slight increase in featherless samples may be due to concentration effects after removal of non-lipid components. These values are comparable with earlier studies. Park *et al.* (2013) [5] reported fat content of 13.26% in chicken head. Similarly, Khiari *et al.* (2014) [3] observed ether extract value of 11.87% in poultry by-product blends. The agreement between the present findings and previous reports suggests that feather inclusion has minimal influence on lipid fraction, as feathers themselves contain negligible fat.

Crude Fibre

Crude fibre content showed a highly significant difference ($p < 0.01$), with values of 4.64% in feathered samples compared to only 0.15% in featherless samples. Animal tissues are inherently low in fibre. Nollet and Toldrá (2011) [4] reported crude fibre content of 0.32% in typical poultry by-products, which aligns with the present finding for featherless samples. However, in feather-containing materials, fibre values increase substantially due to keratin. Khiari *et al.* (2014) [3] reported crude fibre content of 14.60% in feather meal. The value obtained in the present study (4.64%) is lower than pure feather meal but significantly higher than featherless tissue, confirming that feathers are the primary contributor to fibre. This clearly indicates that removal of feathers is essential to improve digestibility and suitability for human consumption.

Total Ash

Total ash content did not differ significantly ($p = 0.742$) between treatments, with values of 33.31% (with feather) and 32.98% (without feather). High ash content is characteristic of bone-rich materials. Khiari *et al.* (2014) [3] reported ash content of 31.25% in poultry bone fractions. Similarly, Park *et al.* (2013) [5] observed ash content of 28.64% in chicken head. The values obtained in the present study are comparable, confirming that quail head is a rich source of minerals, particularly calcium and phosphorus. The absence of significant difference indicates that feathers contribute minimally to mineral content.

Conclusion

The present findings clearly demonstrate that samples with feathers significantly modifies proximate composition by increasing crude protein and fibre due to keratin, while reducing moisture proportion. Although feathered samples show higher crude protein values, this increase is not nutritionally advantageous due to poor digestibility. In contrast, featherless quail head provides a more accurate representation of nutritionally available components and is better suited for food applications. These results highlight the importance of feather removal in enhancing the utilization potential of poultry by-products.

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